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CONSERVATIVE METHODS IN THE SURGERY OF THE CHRONICALLY AND SEVERELY INFECTED KIDNEY

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PHILADELPHIA

I BELIEVE that no one will deny the statement that, of the commoner operations of urology, nephrectomy for pyonephrosis is accompanied by the highest operative mortality. I have found difficulty, however, in determining what this mortality actually is. The term "pyonephrosis" is applied by different persons to different things; the figures given vary tremendously and must, therefore, be regarded with a shrewdly appraising eye. This condition can best be illustrated by a series of mortality figures obtained from the literature. The number of reported series, especially in recent years, is small, as is easily understandable, for the surgery of pyonephrosis is beset with tragedies, it is an unpleasant subject, and there have been no startling therapeutic improvements to encourage the surgeon. The one technical change which has marked a definite advance is preliminary nephrostomy followed by secondary nephrectomy. This procedure has undoubtedly saved many lives, but it is hard to say, from the statistics, just how many.

Table 1 gives the death rates for nephrectomy for pyonephrosis, without regard to whether the nephrectomy was primary or secondary. The figures of Beer, Hryntschak, Scholl and Judd, and Schmidt fall considerably below the others. Hryntschak, as will be seen later, reports a mortality of 29.4 per cent following nephrostomy for pyonephrosis, so that his 24 successful nephrectomies may be regarded as a bit of good fortune. In analyzing the large series of Scholl and Judd, one notes that there were 468 lumbar nephrectomies, including 6 transperitoneal nephrectomies. Of these 54 were extracapsular and 114 subcapsular. Preliminary nephrostomy was carried out in only 7 cases. There were 63 perinephric abscesses, of which 38 were drained some time before the nephrectomy. There is no definite statement of the criteria for the diagnosis of pyonephrosis.

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Bantz, who has made the most careful statistical study of the subject, finds that there has apparently been a marked improvement in the mortality figures since 1929. He guesses that this improvement is due to better preoperative and postoperative care, particularly ureteral catheter drainage and attention to the fluid balance. However, lumping all the data he has been able to collect, he reaches a combined mortality figure of 27 to 30 per cent for nephrectomy for pyonephrosis.

Table 1. *Mortality Rates in Nephrectomy for Pyonephrosis.*

	%
Gerster	14.7
Beer and Hyman (85 cases)	4.7
Hryntschak (24 cases)	0.
Bantz (66 cases)	21.2
Bantz (1929-1932)	12.5
Bantz, stone (34 cases)	29.1
Rihmer (31 cases)	12.9
Schmieden (138 cases)	23.8
Scholl and Judd (471 cases)	2.5
Schmidt (77 cases)	7.8
Schede (11 cases)	27.2
Combined mortality	27.0-30.0

Table 2 shows those series in which primary nephrectomies are separated from secondary nephrectomies; that is, those done after preliminary nephrostomy. Most of these figures are older, and they run distinctly higher than those in Table 1.

Table 2. *Mortality Rates in Primary Nephrectomy for Pyonephrosis.*

	%
Küster	17.0
Gerster (30 cases)	10.0
Schmieden	30.1
Collected by Beer and Hyman	17.0-21.0
Israel	23.0
Bergmann	43.9
Otis	38.8

Table 3 shows the figures for secondary nephrectomies. They are quite comparable with those in Table 2, being in about the same chronological period. The advantages of preliminary drainage appear to be about offset by the fact that the cases so treated are usually more severe.

Table 4 shows some figures as to the results of simple nephrostomy for pyonephrosis. They are all old, and appear to the modern surgeon quite high.

Table 3. *Mortality Rates in Secondary Nephrectomy for Pyonephrosis.*

	%
Tuffier	5.9
Gerster (31 cases)	19.3
Beer and Hyman (18 cases, 13 subcapsular)	11.1
Collected by Beer	17.5
Schmieden	18.0
Israel	50.0

Table 5 shows all the figures I could find on the two-stage operation taken as a whole.

It is obvious that figures such as these are confusing and unsatisfactory, and do not permit the establishment of proper standards for the treatment of pyonephrosis. The reason is not hard to discover. The term "pyonephrosis" has always been inexact from the pathological point of view, and unsuitable from the surgical point of view.

Table 4. *Mortality Rates in Nephrostomy for Pyonephrosis.*

	%
Küster	17.0
Tuffier	23.3
Hryntschak (17 cases)	29.4

There is no distinct dividing line between pyonephrosis and infected hydronephrosis, and when we say "pyonephrosis" we convey no information whatever as to the existence or severity of complications which may be present, and which are of the utmost importance to the surgeon.

As a matter of fact, it makes little difference to the operator whether the obstructed kidney is filled with pus or with clear, sterile urine, so long

Table 5. *Mortality Rates in Two-Stage Operation for Pyonephrosis.*

	%
Tuffier	29.2
Chute (20 cases)	10.0

as there is no perinephric inflammation. We might then create a group of pyonephroses devoid or almost devoid of perinephritic changes. In this group the operative difficulties are minimal. The disease is apt to be of comparatively short duration, but even if the infection is so acute that the patient is extremely ill, and preliminary nephrostomy is the prudent course to follow, the secondary nephrectomy should be easy. The results in this group should be good, provided the opposite kidney is healthy. In short, I believe it would tend to clarify the situation if we abandoned the term "pyonephrosis" for this group and classified the cases as infected hydronephroses, regardless of the character of the contents of the kidney.

This would leave another group in which the extension of the inflammation to the perinephric tissues plays a most important role. Abscesses may occur, and may be single or multiple, large or small, but fibrosis is inevitable, and it is this that determines whether the surgical problem is to be easy or difficult. The fibrosis may involve the entire area about the kidney in an approximately uniform manner, or may be more pronounced in certain areas and less in others. The area most apt to be more densely adherent is that around the hilum of the kidney, where the pedicle, pelvis and ureter are involved. In only a few cases is the fibrosis sharply localized at one point. It may be very extensive about the kidney, and yet not obliterate the line of cleavage between the kidney proper and the inner surface of the true capsule, even though the latter be greatly thickened. It is upon this pathological fact that the operation of subcapsular or intracapsular nephrectomy is based. It avoids the separation of dense and widespread adhesions, in which lies the danger of producing traumatic shock, or injuring other vital organs such as the vena cava, aorta, pleura, intestine, pancreas, liver, and so forth.

This operation, however, does not solve all the problems. With increasing damage to the kidney, the line of demarcation between it and the capsule may be partly or entirely obliterated, and in the extreme degree of this change, nothing may be left but an infected cavity representing the pelvis, surrounded by a dense mass of scar tissue in which it is difficult or impossible to find, even with the microscope, any remnant of kidney tissue. To speak of performing nephrectomy in such a case must be regarded as the result of wishful thinking, because there is really no longer any kidney — it has been destroyed and its boundaries cannot in any way be determined.

In formulating the problem presented by such kidneys, three other factors must be considered. First, there may be a congenital anomaly of the kidney, such as horseshoe kidney, double kidney, ectopia, or polycystic disease, all of which increase the responsibilities and difficulties of the surgeon. Secondly, there may be disease of the opposite kidney, which requires simultaneous treatment or restricts the alternatives available to the surgeon. Thirdly, general disease may be present, and diminish the ability of the patient to withstand extensive surgical procedures.

It must be obvious from this exposition that even in the restricted group of pyonephroses complicated by perinephric fibrosis there are the greatest variations in operative suitability and consequently in prognosis for recovery from operation. It is indeed true, as Chute has said, that "secondary

nephrectomy can never have a standardized classical technic for the reason that the conditions it must meet vary too much to admit of this."

In trying to evolve from these intricacies some method of classification which will permit us to evaluate more accurately the success or failure of surgical treatment, I have despaired of achieving a pathological classification simple enough to be useful. It seems to me that surgeons would do better to classify their cases according to the method of operation adopted, which will permit us to advance by studying carefully the diagnostic means of determining which form of operation will be best, and perhaps by developing new or modified methods of operation suitable to the conditions present.

The operations commonly listed as available under these circumstances are lumbar extracapsular nephrectomy, lumbar intracapsular nephrectomy, transperitoneal nephrectomy and permanent nephrostomy.

It often appears to me that a number of surgeons have come to believe that nothing but nephrectomy is permissible. Facing such a case, they have felt that however reluctant one may be, he must proceed to remove the kidney, and that to maintain his professional reputation he must complete the removal, even if in so doing he inflicts trauma which is almost sure to prove fatal. I wish now to ask whether it would not be better to admit frankly that in some cases it is beyond the power of any human being to remove the kidney and save the patient. This being so, we should study and develop other possible methods of giving relief. Such methods actually do exist, and I venture to hope that they may be amplified and improved in the future.

Keeping in mind the assumption that formal nephrectomy may possibly be avoided, if there is good reason for so doing, every effort should be made to obtain the most complete information about the condition present. In some cases the patient's illness may be so severe that immediate operation — usually nephrostomy — is necessary. If so, studies can be carried out later in the manner I shall presently describe. If the illness is not so severe, the usual thorough urologic study is of course carried out. There is no need to go into details about this, but I should like to call attention to an observation made recently which seems to be of some importance. It was made in the case of a woman of fifty who entered the medical ward of the Jefferson Hospital complaining of weakness, malaise, pallor, loss of appetite and slight daily fever, with no localizing symptoms. Pus was found in the urine. A badly infected pair of tonsils was removed without improvement. Urological study was then carried out, and the pyelogram shown in Figure 1 was obtained. The patient received several blood transfusions, after which, her condition being improved, operation was performed. The operator was Dr. Walter W. Baker, and I was present at the operation and concurred in the decisions made. We believed that nephrostomy was probably the correct procedure, but decided to explore the kidney with the idea that if it separated easily, primary nephrectomy might be carried out. When the kidney was exposed, the presenting surface was not adherent at all, and separated with great ease from the perirenal fat.

Figure 1. *Right pyeloureterogram, showing two large, round dilated calyces and at least three small, irregular cavities near the hilum.*

After this encouragement the dissection was continued, but as we approached the region of the hilum very dense adhesions were encountered. A few of them were separated, when it became evident that the ureter and pedicle were embedded in a solid, extremely firm, fibrotic mass. We felt sure that the patient was in no condition to withstand either the separation of these adhesions or an intracapsular nephrectomy; so we concluded the operation, leaving a drainage tube in the pelvis of the kidney. The patient suffered a circulatory collapse after the operation, from which she recovered after a transfusion, but the collapse recurred the next day and death resulted. Her resistance was even less than we had estimated. On returning to the pyelogram after the operation, it appeared to me that this whole situation was clearly shown in it, and that the findings at operation

might have been foreseen. As you will note in the picture (Fig. 1) there are in the upper and outer parts of the kidney two large, round, smooth cavities, evidently dilated calyces, while below and medially situated are several very irregularly shaped cavities, each much smaller than the round cavities. The pressure in a closed cavity is the same at all points, and the good distribution of the pyelographic medium shows that all parts of the pelvis communicate freely with one another. Therefore, the appearance of this pyelogram can only mean that the upper and outer calyces have dilated freely and easily and without hindrance from any fibrotic change in the capsule or perirenal tissues, while in the more central portion of the kidney the calyces have dilated but slightly and irregularly because they are surrounded and confined by an extensive fibrotic change. Had we observed this fact, we should have made a simple and rapid nephrostomy, and it is quite likely that the patient's life might have been saved. Since this incident, I have restudied a number of pyelograms, and believe that it may be possible to draw from the nature of the pelvic outline fairly accurate inferences as to the degree and location of perinephric fibrosis.

If the surgeon believes that secondary nephrectomy is or may be for any reason inadvisable, and wishes or hopes to avoid it, the nature of the problem depends upon whether or not the kidney is still able to secrete urine.

If the kidney is still secreting considerable quantities of urine, nephrectomy can be avoided only by providing adequate drainage. Unless we accept the undesirable alternative of a permanent nephrostomy, this may be accomplished only by restoring the function of the ureter, by dilatation or by plastic operation. In considering this matter, we should remember that in the early days of urology the great pioneer Albarran recognized the possibility of restoring ureteral drainage, and attempted to place a retention catheter, as large as possible, in the ureter at every nephrostomy. The infection is not necessarily an insuperable obstacle. Let me observe that if an infected kidney can be kept under control by drainage through a rubber tube, it may be controlled equally well by thorough drainage through the ureteral tube.

If the kidney secretes only a small quantity of urine, efforts may be made to remove remaining portions of parenchyma by fragmentation, to interfere with the remaining blood supply, or to cause atrophy by the application of chemicals or deep x-ray. Chemicals such as tannic acid, weak formaldehyde and trichloracetic acid have been suggested, but I have had no experience with them. Schofield speaks highly of the value of x-ray for this purpose. If such efforts are successful, urinary secretion is permanently suppressed, and the considerations outlined in the next paragraph then apply.

If the kidney produces no urine, we are simply dealing with an infected cavity. This cavity may be only the renal pelvis; but if there is a low ureteral obstruction, it may be the pelvis and a dilated ureter; or there may be added the cavity of a perinephric abscess. Whatever it is, it will heal if adequate drainage is provided for a sufficiently long period. The drainage aperture must be of generous size, and drainage materials must be kept in place until firm healing occurs from the bottom of the cavity.

In all such cases very careful thought must be given to the ureter. If the ureter is not dilated, we may assume that the obstruction giving rise to the pyonephrosis is at or near the ureteropelvic junction, and no especial attention need be given the ureter. If, on the contrary, the ureter is dilated, it cannot be disregarded, no matter what kind of surgical attack is employed. The nature of the obstruction then becomes important. If it is a dilatable stricture, suitable dilatation may have very favorable effects, and indeed change the whole nature of the problem. If the obstruction is for any reason not amenable to dilatation, we must deal with the ureter in some positive way, and it is often desirable to do so before attacking the kidney. This is true even if an intracapsular nephrectomy is contemplated, as in this operation ureterectomy is difficult or impossible. The ureter can be dealt with by some plastic or other operation designed to restore its patency, by removal through an inguinal incision, or, if neither of these is possible, by bringing it to or near the surface and draining it thoroughly. Such operations should be carried down to the point of obstruction, wherever it is, as a retained lower end of the dilated ureter is much more apt to give trouble than the upper end. Neglect of the ureter does not always result in failure of an operation on the kidney, but often enough so that no prudent surgeon should be guilty of such neglect.

In deciding what to do in the region of the kidney, observations at the operating table are of the greatest value, as there is no other absolutely certain way to determine whether the kidney falls within the extremely difficult classification. If nephrostomy is done, numerous and extremely valuable methods of study are available after drainage has been provided. The presence or absence of urine in the drainage can be determined. In doubtful cases, the urea content is decisive. Functional studies can be carried out with phenolsulfonphthalein or indigo carmine. Colored solu-

tions injected in the drainage tube will tell us whether any of the pelvic contents are reaching the bladder. Roentgenographic studies are the most instructive. While ordinary retrograde pyelography is possible in many cases, it is usually easier to inject the pyelographic medium directly through the drainage tube. Fluoroscopic observation during the injection shows whether any of the fluid reaches the bladder, and if so, how easily. If the tube is clamped or plugged, one can see how quickly and completely the pelvis empties. Lastly, if there is any chance that ureteral drainage has become adequate, blocking of the drainage tube for twenty-four hours or so answers the question. It is by careful attention to these methods and thoughtful interpretation of the findings that we may hope to make the accurate and reliable preoperative diagnoses which will permit the selection of the best and least dangerous procedure to relieve the patient.

I can add to the literature no large body of statistics on the surgery of pyonephrosis. However, from the records I have available, I have taken 12 cases which I think can fairly be placed in the category of the extremely difficult cases of pyonephrosis with extensive perinephric fibrosis. I have eliminated all frank renal tuberculosis, and a few other cases in which severe perirenal fibrosis was present, but was due to causes other than pyonephrosis, such as trauma. Of these 12 cases, 4 had, in addition, perinephric abscess. Three cases were treated by extracapsular nephrectomy, with 1 death from peritonitis a week after the operation, and 1 other case in which secondary complete ureterectomy was necessary to obtain a cure. One case, with a double kidney and dilated ectopic ureter opening into the urethra, was treated by nephrostomy, followed by resection of the diseased half of the kidney. The ureter was not removed, and by good fortune gave no trouble. In 2 cases nephrectomy was attempted and abandoned, and both these patients died. One case has been described, and the other occurred a good many years ago. I now believe that nephrectomy should not have been attempted in the latter case. Autopsy showed complete fibrosis of the kidney and obliteration of the line of cleavage. One case treated by intracapsular morcellation, 3 treated by nephrostomy and subsequent ureteral dilatation and 2 treated by prolonged drainage gave excellent results and will be described in greater detail. The last 5 of these cases represent the sort of conservative handling which may perhaps come to be granted a place in the treatment of these difficult cases.

Case 1. A 37-year-old, married woman had never been pregnant, but a gynecological operation had been performed 4 years before. One year before admission there began pain in the right-upper quadrant, radiating to the groin, and frequent and painful urination. During the year she lost 70 lb., becoming extremely emaciated. There

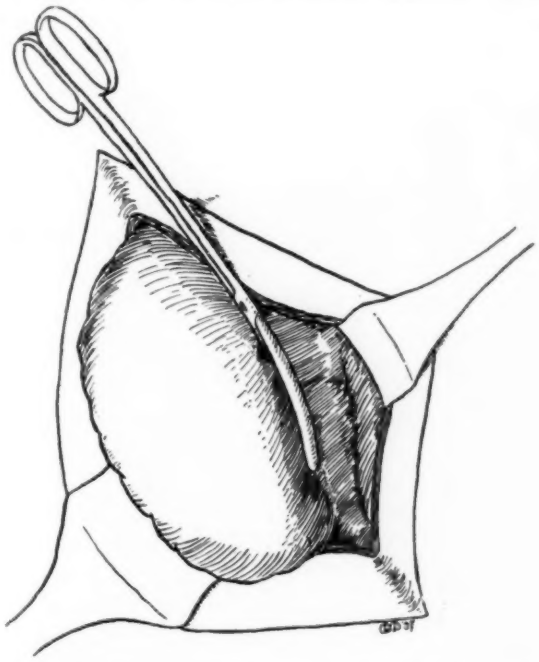

Figure 2. *Diagrammatic representation of the operation performed in Case 1. One blade of the clamp has been thrust into the kidney near the hilum. The reflected and thickened capsule is not shown.*

was a large, tender mass in the right kidney region and an irregular fever. Immediate nephrostomy was performed, with release of nearly a quart of pus. Both pus

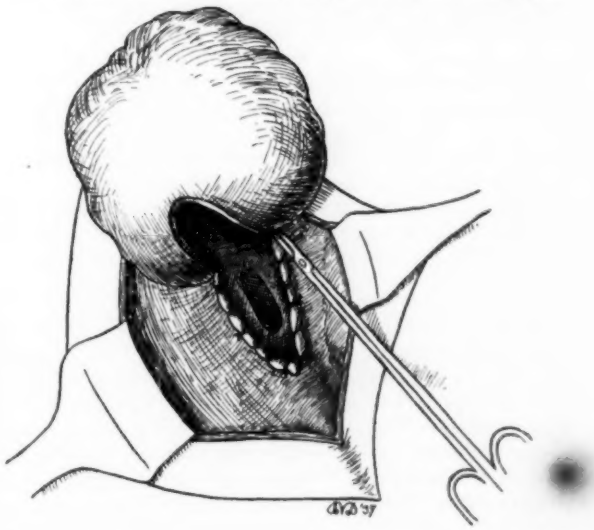

Figure 3. *Operation partly completed. The hemostatic sutures and ligatures are shown.*

and urine contained *Escherichia coli communis.* Improvement was rapid and uninterrupted. The drainage tube was unfortunately removed by her family physician after 3 or 4 months, but the fistula remained open and at the end

of 6 months there were no bad effects, except that x-ray studies were rendered impracticable. Secondary nephrectomy was attempted. The capsule was 2 cm. thick and very tough, and the ureter, pelvis and pedicle were imbedded in such extensive masses of scar tissue that it was

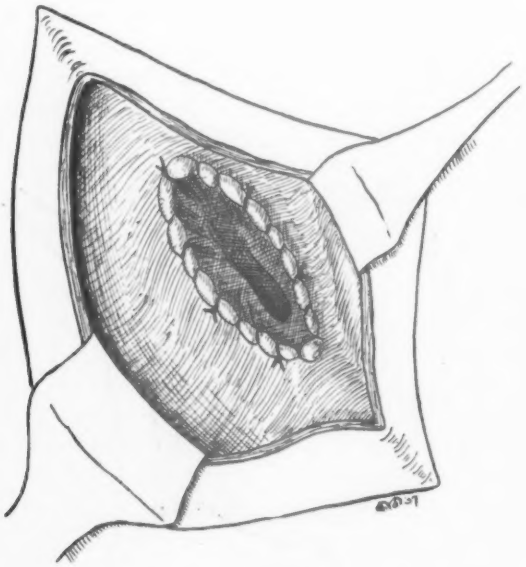

Figure 4. *Operation completed. The pelvis is left widely open; drains were placed well down into the pelvis.*

considered unsafe to free them. After dividing the capsule and pushing it away from the kidney as well as possible, one blade of a large curved clamp was thrust through the kidney cortex into the pelvis as far down toward the hilum as possible (Fig. 2). The kidney was cut away above the clamp. By repeating this process, the entire pelvis was encircled (Figs. 3 and 4). Hemostasis was obtained by mattress sutures or ligatures, according to the length of the bite of the clamp. The entire extrarenal pelvis, ureter and pedicle were left behind, but all parenchymal tissue appeared to have been removed. Drains were placed in the pelvis. A tube was kept in place about 2 months, being shortened only as it was forced out by the healing process. By this time healing was complete, and the patient has remained perfectly well and free from symptoms. I include this case to illustrate a variant in the method of performing intracapsular nephrectomy. It has probably been used before, but I have not found a description of it.

Case 2. A 53-year-old woman had severe pain in the right kidney region, with fever and chills. Examination showed the right kidney pelvis dilated and filled with pus, and the pyelogram (Fig. 5) aroused a suspicion of polycystic kidney. The patient was so ill that a right nephrostomy was done, at which time the diagnosis of polycystic kidney was confirmed. While she was convalescing from this operation the other kidney became heavily infected, and left nephrostomy was necessary. The pelvis again was found to be full of pus (Fig. 6). Ten days later the fever recurred, and exploration revealed a large abscess around the upper part of the left ureter. This was drained, and all the drains were maintained for nearly 8 weeks. During the first half of this period the patient had continuous high fever and chills, but after these subsided the ureters were cautiously dilated, as it was out of the

Figure 5. *Case 2. Right pyeloureterogram, showing dilatation and deformity characteristic of a polycystic kidney. The ureter is irregular, but not markedly dilated.*

question to consider removal of either kidney. As a result of this, all the sinuses healed and the patient was able to leave the hospital in good condition, although of course the urine was still infected.

Figure 6. *Case 2. Left pyelogram, showing dilatation and deformity.*

Case 3. A 47-year-old man entered the surgical ward of the Jefferson Hospital complaining of extreme pain in the right side of the abdomen, with muscular rigidity, fever and leukocytosis. An emergency laparotomy was performed, and an essentially normal appendix was found. A mass was palpated in the region of the right kidney. The symptoms continued and in fact grew worse, with high fever and chills, so that a few days later, after transfer to the Urological Service, operation on the right kidney was necessary. Figure 7 shows the intravenous urogram

Figure 7. *Case 3. Right pyeloureterogram. Note the large opaque mass occupying the right half of the upper abdomen, the dilated pelvis, and the mottled appearance due to a poor mixture of the pyelographic medium with thick pus. The arrow marks a ureteral calculus.*

with dilated pelvis lying in a large area of density, and a questionable stone shadow in the region of the lower ureter. A large perirenal abscess was found, with marked fibrotic changes about it. Beneath the abscess could be palpated a large, flabby kidney, and a fistula was found leading to the pelvis. The abscess and the kidney pelvis were drained with rubber tubes. Improvement was immediate and pronounced, and subsequent pyelographic studies, made by injecting the medium through the drainage tubes, showed the pelvis enlarged, and the ureter dilated down to a point just below the iliac artery, where a good-sized calculus was lodged. The patient felt so well that he importuned us to remove the tube, but this was not done until, as a result of repeated ureteral dilatation as high as 16 French, the stone was passed. Since the injection of colored fluid now demonstrated excellent ureteral drainage, the tube was removed. The sinus immediately closed, and the state of well-being was such that the patient neglected the advice given him to undergo systematic ureteral dilatation. He gained about 30 lb., but in about 4 months fever and pain recurred and the loin sinus reopened and discharged large amounts of pus. There was some difficulty in passing an instrument up the ureter, but once it was accomplished the sinus healed at once. Subsequently the ureter was dilated at increasing intervals with a No. 14 bulb, and the patient has remained perfectly well. Figure 8, an intravenous urogram, shows

Figure 8. *Case 3. Intravenous urogram. The ureter has been dilated, the stone has passed, and the nephrostomy tube has been removed. Note the small size of the pelvis and the sharp calyces.*

how markedly the right renal pelvis had contracted and returned toward normal.

Case 4. A 54-year-old man had had for 16 years recurrent attacks of pain on the right side, and 10 years before admission a large stone had been removed by operation from the right kidney. Two years later he had passed blood. For 7 years he had been known to have diabetes, which was controlled by dietary treatment. For 5 years he had passed blood and pus at frequent intervals, and had lost 50 lb. For 3 weeks there had been pain in the right side, fever to 101°F. and hematuria. Examination showed the typical features of horseshoe kidney (Fig. 9), with marked hydronephrosis and hydroureter on the right, narrowing of the ureter at its lower end and a few stone shadows in the kidney area. The urine contained pus and a few streptococci. Urine from the left pelvis was normal, with excellent function (Fig. 10), but only a trace of phenolsulfonphthalein came from the right side. An operation, planned to be a heminephrectomy, was carried out. After a very thick Gerota's capsule had been cut through, a large perinephric abscess

was opened. Within the abscess lay the kidney, which was densely adherent. It was felt that the circumstances, including the existence of the isthmus, did not permit intracapsular nephrectomy, and indeed that the excessively dense adhesions in every direction would prevent one from ever removing the kidney with any degree of safety. Drainage tubes were therefore placed in the abscess cavity

Figure 9. *Case 4. Right pyeloureterogram showing a dilated pelvis, mottled appearance, a deformity characteristic of a horseshoe kidney, and a dilated ureter with stenoses in the lower third. The lower border of isthmus can be seen.*

and in the pelvis with the idea that the nephrostomy would probably have to be made permanent. The convalescence was extremely complicated. The diabetes was difficult to control. Subacute postoperative gangrene developed in the incision, requiring a wide excision of skin and subcutaneous tissue, protracted dressing with zinc peroxide paste and eventual skin grafting. First one epididymis and then the other became acutely inflamed, but neither suppurated. Acid-fast bacilli were found in the urine once, but later studies were negative. These misfortunes kept the patient in the hospital 3 months, during which time purulent urine drained constantly from the nephrostomy tube. I decided to attempt to restore ureteral drainage, hoping to be able to dilate the stenosis demonstrated in the lower ureter. Ureteral meatotomy was necessary, after which dilatation was eventually carried to No. 16½ French. The posterior edge of the vesical orifice, which was prominent, was incised with the Collings electrode. After this, fluoroscopic examination showed that Skiodan solution injected in the nephrostomy tube passed quickly and completely to the bladder (Fig. 11).

Figure 10. *Case 4. Left pyeloureterogram showing some dilatation and deformity characteristic of a horseshoe kidney. Note the absence of a mottled appearance in the pelvis.*

The tube was therefore tightly corked for 3 days, with no untoward symptoms whatever. It was then considered safe to withdraw it, and the fistula healed promptly. Eight months later the patient had gained 50 lb., felt very well with no symptoms whatever and was hard at work. The urine still contained pus and a few streptococci. I feel that further operation in this case would have been unjustifiably dangerous, and although an infected kidney is still present, it can be controlled by an occasional ureteral dilatation.

Case 5. This patient was a 26-year-old man; at the age of 5, a large right hydronephrosis had been drained, and the resulting sinus had discharged purulent material ever since. Two subsequent operations had been performed, at one of which a large stone had been removed, and possibly part of the kidney. Examination showed a large, irregular mass beneath the sinus. The urine was perfectly normal and the right ureter evidently completely occluded, as no ureteral orifice could be found with the cystoscope. The sinus was injected with Skiodan solution and was observed under the fluoroscope, and films were taken. They showed an ovoid mass beneath the sinus, and in the middle of it the Skiodan outlined an irregular kidney pelvis with large, rounded calyces. The Skiodan had also penetrated the ureter, which was very narrow near the kidney,

and was greatly dilated and convoluted in its lower portion, which extended almost to the bladder (Fig. 12). I felt that nephrectomy, to be successful, would have to be preceded by removal of this hugely dilated and infected ureter. This was accordingly undertaken, and was found to be very difficult. The peritoneum was extensively torn. A small portion of the lower end of the ureter had to be left in place, and was thoroughly drained. The upper end

Figure 11. *Case 4. Right pyeloureterogram made by injecting Skiodan solution through the nephrostomy tube. The ureter has been dilated. Note the small size of the pelvis, and that most of the solution is in the bladder.*

was brought as near the surface as possible and drained with a large tube. This procedure was so arduous that it was considered wise to postpone the attack on the kidney. The incision healed per primam, and 3 weeks later the old sinus was excised and its lower portion split with a view to intracapsular nephrectomy. Neither kidney tissue nor line of cleavage could be found, although the cavity representing the pelvis was widely opened. During this dissection several small arteries were divided, and either ligated or closed by packing. This may have assisted in completing the atrophy of any small remnants of secreting tissue remaining. The entire large mass of scar tissue could have been removed only by sharp dissection, and I considered this unjustifiable in the absence of all landmarks, so that large drains were inserted and the operation was concluded. The drainage sinus from the lower end of the ureter healed very promptly. Drainage tubes were kept in the sinuses leading to the upper end of the ureter and to the kidney pelvis until they were extruded by the healing process, and no urine was ever detected in the drainage. Both sinuses were completely healed 4 months after the last operation. The patient was under observation for 6 months after healing was complete. He felt very well, had no symptoms and gained much weight. The mass in the right kidney

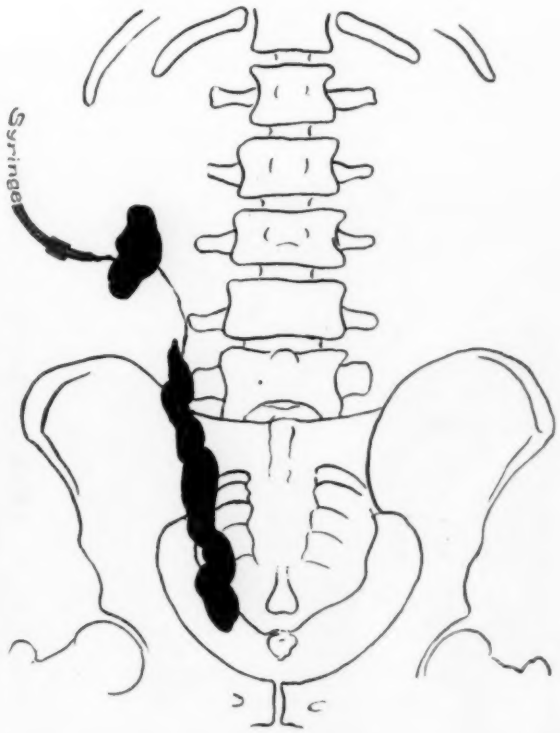

Figure 12. *Case 5. Diagram representing the x-ray findings after injecting Skiodan solution through the drainage sinus. Note the large, dilated ureter, and that no solution has entered the bladder.*

region was not tender in the slightest degree, and became markedly smaller. I feel that this treatment was by far the best solution for this young man, and cure would have been impossible so long as the dilated ureter remained in place.

Case 6. A 43-year-old, married woman, with two children, complained of frequent, painful and urgent urination for 2 years, and a painful and tender swelling in the right flank for 5 weeks, with loss of weight of 10 lb. Seven years before she had been told that she had a floating right kidney. Ureteral catheterization was impossible. At operation a perinephric abscess was found, extending down into the iliac fossa. It and a large pyonephrotic cavity were drained. Following the operation, no urine was detected in the drainage at any time. A pyelogram was made by injection through the tube (Fig. 13), showing a dilated pelvis. There was no ureteral filling, so that the underlying obstruction was undoubtedly at or near the ureteropelvic junction. The patient did so well that nephrectomy was attempted 9 days later. The operation note made at this time states:

> "The incision has healed in a remarkable way in spite of the presence of so much pus. There has never been any sign of urinary drainage. The old incision is reopened with some difficulty. The perirenal fat is extremely indurated. Efforts are made to dissect down

to the kidney around the drainage sinus, but nowhere is any recognizable kidney tissue found or any line of cleavage indicating the capsule. The finger in the drainage sinus feels firm trabeculae characteristic of a hydronephrotic kidney pelvis. Efforts are made in various directions to dissect the kidney and posteriorly the vena cava is exposed. The finger is passed below the lower pole of the kidney, but it is impossible to tell whether this is inside or outside the perirenal fat. The peritoneum is dense adherent to the kidney anteriorly and medially.

"In view of these findings and of the fact that all this palpation discloses no noteworthy kidney sub-

Figure 13. *Case 6. Right pyelogram made by injecting sodium-iodide solution through the nephrostomy tube. Another drainage tube is in the perinephric abscess cavity. Note that none of the solution has entered the ureter.*

stance, and of the fact that no urine has been secreted through the drainage tube, it is decided not to attempt further to remove the kidney. I feel that removal of the kidney here would be extremely dangerous to the patient's life. A drainage tube is placed in the kidney pelvis and packed around with gauze. A second drainage tube is placed in the abscess in the iliac fossa. Cigarette drain to the postrenal space. Closure by through and through sutures of silkworm gut.

"I think that the abscess in the iliac fossa will heal promptly. The tube will be kept in the kidney pelvis as long as possible, preferably 2 to 4 months. I believe that the sinus will then close and there will be no further drainage. Should any further operation be necessary, it should be transperitoneal on account of the destruction of all landmarks about the kidney."

The tissue removed for examination showed no trace of any renal elements. The tube remained in place about 2½ months, when it was forced out by the healing process. The patient has remained well and entirely free of symptoms for nearly a year, and has gained about 30 lb.

* * *

I am sure that every urologist has had experiences similar to mine in dealing with pyonephrosis. When the results have been poor, I believe that they are usually due to the extreme difficulties inherent in the situation. I venture to make a plea that there be more discussion of these difficulties, and of means of circumventing them, and hope that even if my contribution is considered of small importance, it may stimulate further consideration of these knotty problems.

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Discussion

Dr. Fletcher H. Colby: Dr. Davis has given us a very interesting paper. He brings up a very difficult problem and one which we all meet. His solution is new to me and is probably new to many others. His experience in pyogenic infections of the ureters has been similar to my own, which is this: ureters infected with tuberculosis seldom have to be removed; those infected with pyogenic organisms are much more apt to cause trouble.

Dr. William C. Quinby: I think we are very fortunate in having such a clear-cut picture of this subject. I had reason to look up this type of case in our clinic rather recently, and while I do not have the exact figures based on the approximately 150 cases operated upon, there was a mortality of 13 per cent; this includes drainage cases as well as nephrectomies of all kinds. The patients are usually very sick, as we all know, and each demands one's best judgment as well as one's most daring operative skill. There is, I think, one thing worth bringing out, that is the importance of handling the infection and at the same time of providing adequate hemostasis. Cases fall roughly into two such groups so far as the diagnosis is concerned. If the infection is relatively recent, and if one finds a very large, swollen, soft, succulent kidney thoroughly infiltrated with pus, the danger is greater than with a kidney whose condition will be changed for the better by prolonged drainage through nephrostomy. However, where there is only a relatively large or small pus sac the problem is that of handling the infection rather than one of vascular supply. As Dr. Davis has pointed out in one or two of the cases he mentioned, there is often very little